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EDITORIAL NOTES

THE AMERICAN GAS INDUSTRY

THE year 1940 proved one of great progress for the American Gas Industry, and we hasten to congratulate our colleagues on their excellent record. The Gas Industry there faces 1941 in an "all-time high" state, and, we are assured, with confidence and determination. It now serves a total of 17,980,300 consumers—the largest number ever connected to the mains, an increase of nearly 500,000 over the year 1939. Of these, 10,232,900 were served by the manufactured gas industry and the remaining 7,747,400 by the natural gas industry. Sales of manufactured gas for domestic purposes, amounting to 267,438 million cu.ft., showed an increase of 7.3% for the twelve months, house heating sales making a gain of 25%. Natural gas sales registered a gain of over 12%. As for industrial sales, manufactured gas was up by 7.7%, natural gas by 9.9%.

The American Gas Industry is taking a leading part in supplying the vast industrial heating needs of factories and mills that are producing the thousands of parts for equipment and machines necessary in the National Defence programme. For hardening the small and intricate parts of machine guns to the final treatment of the largest guns specially designed gas furnaces are speeding production at an ever-increasing pace. In the navy yards some of the largest industrial furnaces ever built are annealing fully assembled gun turrets with gas. We had occasion to comment on some of the work undertaken in this direction in the "JOURNAL" of Jan. 8. The point is that equipment which has been developed for peacetime uses during the last decade, developed through co-operative research and engineering by gas undertakings and leading equipment manufacturers under the sponsorship of the American Gas Association, is rapidly being put to work to speed up production in war industries. The benefits are being reaped in America—as, indeed, in our own country—of systematically planned and far-sighted policies. This research and development is being continued on a wider scale; it will result in even better and more efficient gas equipment. An interesting engineering achievement during the year was the installation at Cleveland, Ohio, of a plant which reduces natural gas to the liquid state and stores the liquid in special containers, from which it is fed into the distribution mains. Some of the advantages foreseen in this plant are a substantial saving in storage facilities, the ready availability of a gas supply in case of emergencies, and the ability to maintain uninterrupted service during periods of severe peak loads

Regarding research and training in the Gas Industry in the States, we are interested to learn of a proposal which has been put forward vigorously for the establishment of an Institute of Gas Technology to be separate from the A.G.A. Laboratory, which is concerned primarily with the development of appliances and equipment and the establishment and maintenance of operating standards. The aim is an organization to tackle major industry-wide problems as well as local problems for individual members effectively at low cost, preventing overlapping and duplication of research. The plan appeals to us, particularly as such a laboratory would be incorporated in an already established institution affiliated with some university. The programme envisages the provision of trained personnel for absorption by the Industry; a staff of trained specialists who, through their instructional duties and consequent close association with the problems of the Industry, would use their special research knowledge in the field; and fundamental research data gathered in connexion with student theses submitted as a part of the requirement for advanced degrees. As we have said, the aims appeal to us, and we suggest that those responsible for the setting up of such a training and research Institute would gain much from knowledge of the working of the Fuel Department at Leeds University in co-operation with the Institution of Gas Engineers. We discussed recent progress at Leeds in these columns on Feb. 19 last, when we pointed with gratification to the collaboration established between the Fuel Department and the Yorkshire Industrial Gas Development Centre—collaboration which has advantages for all concerned. The closer the link between student and research worker and the Industry which applies that research, the better.

THE GAS ENGINE LOAD

IT is just a year ago since we commented on the awakening of the American Gas Industry to the potentialities of the gas engine load and the growing installation of gas engines for such purposes as refrigeration, electricity generation, water pumping, and air-conditioning. The major portion of the load is being gained by natural gas, but the manufactured gas undertakings are developing the business also and adjusting their rates to bring gas within the competitive field. We have just received from the American Gas Association a copy of their Gas Engine Power Committee's report for 1940, and it makes good and encouraging reading. It consists of a report of the findings of a survey of natural gas undertakings having gas engine loads, and it shows that there are now twice as many gas engine installations as existed four years ago, and that the greatest development of the field is among those industries where the smaller sizes of gas engine are adequate for their requirements. The survey omits from consideration gas engines used by gas undertakings themselves and also any engines temporarily installed. The conclusions thus reflect industrial acceptance of gas engines installed on their own merits. Much of the A.G.A. Committee's report has to do with the lubrication of gas engines and emphasis is laid on high-temperature cooling, because of the great possibilities in regard to waste heat recovery following this method of engine operation. The report considers 46 engines, varying in size from 40 to 250 h.p., which were observed over periods of from 12 to 18 months at cooling water temperatures from 215° to 230°F. as distinct from the conventional 160°F. It is reported that dependability has been good in all cases, and in many instances better than with engines operating at lower cooling water temperatures, oil consumptions have been no greater, cylinder wear has been either normal or very low indeed, and tests showed a slight increase in horse-power under full load conditions with the same quantity of fuel. As a result of these and other considerations the A.G.A. Committee feels that "it is now possible safely to advocate the use of high-temperature cooling wherever waste heat may be utilized to advantage." Although the volumetric efficiency of the gas engine is probably

reduced somewhat by the higher jacket temperature under maximum load, this loss is apparently offset by increased mechanical efficiency through reduction of oil drag in the engine.

We have for long felt that the development of the gas engine load should be taken more seriously in our own country, and we shall certainly follow investigational work by the American Gas Industry with keen interest. Further work is to be undertaken on the following lines (among others) by the American Gas Association: A study of plans for financing the sale of gas engines, particularly those which would assist the small dealer; continuation of the study of waste heat utilization; and the development of sales technique.

HEAT TREATMENT OF METALS

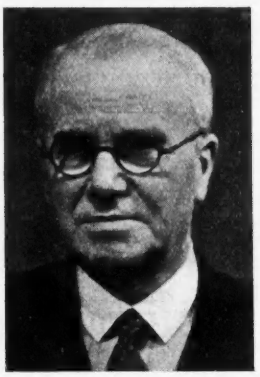
WE have done a good deal of work in recent years on the application of special atmospheres, having as their source town gas, in this country. Investigations carried out by the Research Department of the Sheffield Gas Company have been especially notable in this connexion. This Company has undoubtedly added greatly to the knowledge of the action of gases on metals, not merely from a theoretical aspect, but in the production of gas-heated furnaces of original design embodying such knowledge in a manner of very great industrial value. The Company's atmosphere control process for the treatment of steels up to temperatures of 1,350°C. is well known. Nor has research been confined to the treatment of steel; work has been carried out over a long period now on the action of gases on non-ferrous metals, which work has made possible the putting into operation of eminently practical and economic installations. All this research is proving of the greatest importance at the present time in the manufacture of war materials. The American Gas Industry, too, has been by no means idle in investigating and applying special atmospheres for the heat treatment of metals. In this regard an informative and helpful Paper was recently given to the American Chemical Society by Messrs. C. R. Cline and C. G. Segeler, of the American Gas Association, in which the Authors tabulated the general methods of producing the special atmospheres and indicated their principal applications. We commence publication of this Paper on later pages of our issue to-day.

Special atmospheres have made possible three achievem nts which have revolutionized metal manufacturing—clean heat-treatment of low carbon steels and non-ferrous metals, bright hardening of medium and high carbon steels without oxidation or decarburization, and bright treatments for high carbon and alloy steels. Metal treating has been the largest field in which prepared atmospheres have been applied, but it has by no means been the only one. "The metallurgical industries"—we quote from the Paper to which we have referred—"are only beginning to apply these methods for the reduction of ores. . . . At least two and possibly three mining companies are experimenting with the direct reduction of iron ore with special atmospheres made from gas, which, if successful, will be truly revolutionary in character. . . . Chemical manufacturers handling inflammable liquids have used inert atmospheres for fire protection and for purging. Theoretically, boiler flue gases from any fuel might be applied for this work, but practice has shown the desirability of using controllable independent special atmosphere generation in order to avoid the hazard of introducing air, which may happen so easily in the case of boiler gases. In the related paint and varnish field applications of inert atmospheres for agitating linseed oil and blanketing it against fire hazards are growing rapidly. Because the results of applied special atmospheres improve the quality and finish in so many products, there is certain to be a definite change in specification for many different classes of merchandize. Not only is it possible to make better looking products, but the bright finishes and hard surfaces make new applications practical. In no field is this likely to become of greater significance than in our programme of National Defence." These are the conclusions resulting from long-term research sponsored by the American Gas Association. The work is going forward; it will be followed in Great Britain with keen interest.

Personal

Mr. G. A. Mallett

After 56 years' service with the Ipswich Gas Light Company, during which he rose from the lowliest position on the clerical staff to that of General Manager and Secretary, Mr. George A. Mallett, retired from the latter offices last Friday.



In 1884 Mr. Mallett became the first junior clerk to the Ipswich Gas Light Company, and subsequently successively filled the positions of Chief Clerk, Cashier, and Accountant, Secretary, and General Manager. He is Suffolk County Chairman of the London and Counties Coke Association, District Chairman of the Federation of Gas Employers and an Executive member of the National Gas Council.

For many years he has been a member of the Ipswich Chamber of Commerce, being its President in 1927. He was also formerly a member of the Town Council, and in 1934 was elected to the mayoralty. He is still a member of the Ipswich Education Committee and the Assessment Committee, and is also on the panel of the Assistance Board. With the Ipswich Rotary Club, too, he has been prominently identified, serving as President in 1932.

Mr. Mallett, who was appointed a Director of the Company at the annual meeting on Feb. 21, intends to retain his present offices in the national organizations of the Gas Industry, while his retirement will also not involve any diminution of his public work in the town.

* * *

The positions relinquished by Mr. Mallett will in future be filled by two of the present members of the Company's staff. Mr. W. J. COLLINS GARRARD, the Engineer, becomes Engineer and Manager, and Mr. A. W. MATHER, the Accountant, is now Secretary.

* * *

The marriage took place on Feb. 15 of Mr. STANLEY CLAYTON THOMSON, of Clayton, Son & Co., Ltd., Gas and Constructional Engineers, Hunslet, Leeds, to Miss Sheila Armitage Brook, daughter of Lieut.-Colonel and Mrs. Frank Brook, of Milner Bank, Otley. The ceremony took place at Otley Parish Church.

* * *

The marriage took place on Feb. 14 of C. RAYMOND WILKIN, the Manager of the Rochdale Road and Droylsden Gas-Works, Manchester, and Marion, only daughter of Mrs. Tooley and the late Mr. G. W. Tooley. Mr. Tooley was well known in the Gas Industry as the patentee of the " Tooley " dry main, and also as Manager of the Rochdale Road Works.

Obituary

We regret to announce the death of Mrs. A. I. Medcalf, wife of Mr. T. MEDCALF, Chairman of the Swindon United Gas Company.

* * *

The death took place on Feb. 24 of Mr. WILLIAM HENRY NOCK, who for the past 29 years had been on the Board of Directors of the Wellington Tube Works, Ltd. Mr. Nock had been in the service of the Company for over sixty years, and was also on the Board of the Victoria Tube Co., Ltd., and Messrs. Edward Smith, Ltd., since the date of their association with the Wellington Tube Works, Ltd. His passing will be deeply regretted by the large number of friends with whom he associated in his industrial career.

* * *

Mr. FRANK KILPATRICK, a Director of the Plymouth Gas Company, died at Portsmouth last week. By reason of his expert knowledge of the Gas Industry and of the tar and residual products business he was in 1934 also appointed to the Board of the Portsmouth and Gosport Gas Company.

* * *

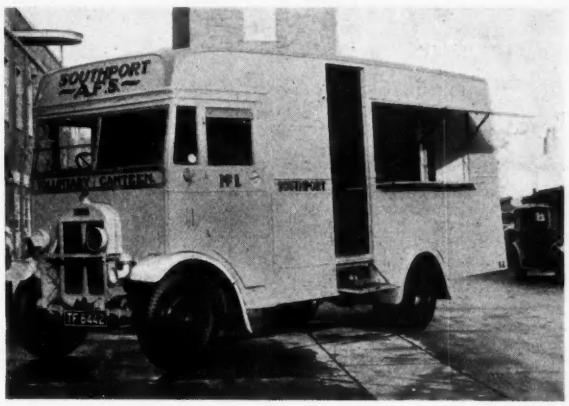
The death has occurred at Kibworth Harcourt, Leics., of Mr. FRANK LOVEDAY, for many years until his retirement Secretary of the Kibworth Gas Company.

* * *

Mr. E. L. OUGHTON, District Research Officer to the South Suburban Gas Company, died on March 1 following a short illness. Prior to joining the South Suburban Company in 1923, Mr. Oughton was with the Longwood Gas Company, Yorkshire, during which period he was an active member of the Yorkshire Junior Gas Association. He was prominently associated with the educational side of the Industry, having been a lecturer on gas supply subjects at the Westminster Technical Institute, as well as on the Education Committees of the Institution of Gas Engineers and the Institution of Heating and Ventilating Engineers. He was a pioneer of the Gas Salesmen's Circle movement.

Gas Used in Southport's A.F.S. Mobile Canteen

Early in January a group of members of the Southport Auxiliary Fire Service, pooling their experiences of fire-fighting in the recent "blitzes," decided that a mobile canteen would be of inestimable value. They resolved forthwith to raise by private subscription among friends and wellwishers in the Borough a minimum sum of £375 and to build such a canteen primarily to serve the Southport Auxiliary Fire Service during their fire-fighting periods, but also to be available to all members of the public in an emergency. Our photograph shows the result.



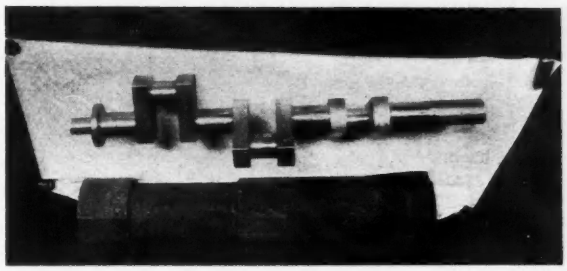
The main water supply of 65 gallons is carried in a specially designed tank over the driving cab but concealed under the roof. The heating equipment consists of a water boiler furnishing 210 pints of hot or boiling water per hour, and two gas cookers, all run on coal gas compressed in cylinders. Constructive support was received from the Gas Departments of Wallasey, Southport, and Liverpool in this sphere. Four cylinders, each with a capacity of 350 cu.ft., were installed at Wallasey on Jan. 27–28. A flexible coupling has also been fitted to enable the canteen to be connected up to the gas supply at certain emergency rest centres and thus conserve the supply of compressed gas in the cylinders. A roomy sink, draining boards, and cupboards to hold all utensils have been fitted, and two serving hatches are situated on the near side of the vehicle, while there are also broad counters for cutting up and serving purposes.

Some Time Ago the Scunthorpe Town Council sought permission to put in a 12 in. and 6 in. gas trunk main to Ashby, but the Board of Trade was of the opinion that an 8 in. main would be sufficient. The Council decided to place the matter before the Board again, and they have now agreed to issue a permit for the work to be done in accordance with the suggestions of the Council. The Council, at a recent meeting, decided to make application for a loan of £1,556 to cover the work. It was reported by the Gas Committee to a recent meeting of the Scunthorpe Town Council that a Consulting Engineer should be invited to make a report on the Council's scheme for using coke oven gas in place of gas manufactured at its own plant.

1941 "Journal" Directory

In order that subscribers may keep the particulars contained in the Directory up-to-date, we summarize below such changes of which we have been advised during last month.

Page 50. NEWCASTLE-UNDER-LYNE. Phone: 69281–2.
" 92. PAISLEY. Phone: 3106–7.
" 62. SHEFFIELD. R. Halkett, D., G. M., & S.
" 64. SLEAFORD. S. Hands, D., E., & M.
" 36. IPSWICH. W. J. Collins Garrard, appointed E. & M.; A. W. Mather, appointed S.; *vice* G. A. Mallett, retired.



Mr. C. S. Shapley, Engineer and General Manager of the Leeds Gas Department, sends us this photograph as showing what can be done at gas-works in an emergency. "We had," he explains, "the misfortune to break two three-throw cranks in quick succession on the hydraulic travelling motor of the charging machines, and in view of the difficulty of obtaining new ones our foreman-smith and foreman-fitter set about the job of making replacements. The photograph shows the original metal and the finished product."

Dividend Announcements

South-Eastern Gas Corporation

The Directors of South-Eastern Gas Corporation, Ltd., announce that the dividends on the 4½% redeemable preference shares and on the 4% irredeemable preference shares in respect of the six months ending March 31, 1941, will be paid on that date.

Wandsworth

At a meeting of the Directors of the Wandsworth & District Gas Company held on Feb. 25 it was decided to recommend to the Proprietors at the Annual General Meeting to be held on March 11 the following dividends in respect of the half-year ended Dec. 31, 1940:

On the 4% Preference Stock—£4% per annum.
" Consolidated Stock—£4% per annum.

Woking

At a meeting of the Directors of the Woking & District Gas Company held on Feb. 25, it was decided to recommend to the proprietors at the Annual General Meeting to be held on March 11 the following dividends in respect of the half-year ended Dec. 31, 1940:

On the "A" Ordinary Stock—£11% per annum.
" "B" " " —£7 14s.% per annum.
" "C" Preference Stock—£5% per annum.
" 4% " " —£4% per annum.

In view of the threatened wheat shortage the current showroom window display of the Alliance and Dublin Consumers' Gas Company deals with various methods of preparing and cooking available foodstuffs—oatmeal and root crops.

Devices for the Detection of Incendiary Bombs

It is obvious that any means that will assist in preventing the development of fires caused by incendiary bombs will not only relieve hard-pressed fire brigades and save valuable property, but will also reduce or eliminate illuminated targets for subsequent enemy bombers. One such means is to ensure that the presence of an incendiary bomb is detected as soon as possible, and with a view to assisting in the development of satisfactory systems for the detection of incendiary bombs a memorandum has been published by the Institution of Electrical Engineers in the form of a report by the Committee which was set up at the request of the Ministry of Home Security, and a specification has been published by the British Standards Institution.

Where fire detection devices are not installed, the first indication that an incendiary bomb has fallen on premises may often be when a passer-by, patrolling warden, or policeman notices smoke or flame coming through the windows or the roof. Although a watcher is employed, a bomb may fall at the other end of his patrol and may remain undetected and burning inside the building for that vital initial period when it could probably be put out with local appliances.

Several methods of detection are possible, and their cost may vary from a few pounds—even perhaps a few shillings—for a simple arrangement applicable to a house or small property, to several hundred pounds for the protection of large premises.

The I.E.E. report points out that there are several different principles on which the detection system can operate, such as the impact of the bomb as it hits the roof or other obstruction, the sound caused by the arrival of the bomb, the light emitted by the bomb, the products of combustion, or the heat given out by the bomb. Detectors working on each of these principles are possible, and in some cases commercial systems suitable for detecting incendiary bomb fires are available. Their main characteristics and possibilities have been reviewed by the Committee, and a few known installations are described in some detail.

Adaptations of some of the systems described, involving the use of simply-constructed apparatus, are, of course, possible. It is emphasized that while 100% efficiency is unlikely to be secured, and that several methods are still untried, there is reason to believe that the number and extent of fires can be materially reduced by preventive measures of the character indicated in the report. The Ministry of Home Security has initiated certain experimental and research work in order further to ascertain the capabilities of some systems of fire detection, and a specification for one system of detection has already been published by the British Standards Institution.

This specification deals with fire detectors of the heat-sensitive type. This will in due course be followed by specifications for other types of detector. The specification for heat-sensitive detectors is designed to ensure the reliable performance of devices which cause an electric alarm to be sounded either when the fire causes the temperature to rise to a certain value, or when the temperature rapidly increases. Such devices include thermostats and devices which operate by virtue of the melting of an alloy or wax, or by the expansion of a liquid. The method of testing the detector is defined and notes are given on the selection, installation, and maintenance of detection systems.

Copies of the Specification (BS/ARP 53) may be obtained from the British Standards Institution, 28, Victoria Street, London, S.W. 1, price 4d., post free; and copies of the Memorandum on Fire Detection Devices may be obtained either from the British Standards Institution or from the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C. 2, price 6d., post free.

North British Association of Gas Managers

It is the intention of the North British Association to have their Spring Meeting in Glasgow on April 4 next.

Owing to the recent death of Mr. Kellock, the President, who in the ordinary course would have presented his Presidential Address at this meeting, it has been arranged for two short Papers to be read. The meeting will be held in the Ca'dora Restaurant, and the Papers will be submitted by Mr. C. A. Poulson, of West's Gas Improvement Company, Ltd., and Mr. Alexander Bujnowski, of Glasgow.

Institution of Gas Engineers

The following alterations of the times of meetings of the Institution have been made:

Monday, March 10: 1.45 p.m., Membership Committee (instead of 2.15 p.m.). 2.15 p.m., Finance Committee (instead of 1.45 p.m.)

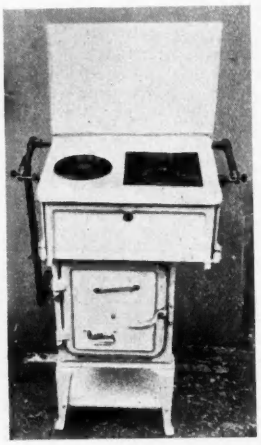
A New Rawlbolt Chart

The Rawlplug Co., Ltd., Cromwell Road, London, S.W. 7, report that the popularity of the Rawlbolt in speeding up war production is reflected in an increase of over 300% in sales since the beginning of the war. During recent months various alterations have been made in the range of Rawlbolts, and a new reference chart is now available, bringing the range completely up to date. The chart illustrates the Rawlbolts in their actual sizes.

Electric Cookers Converted to Gas

Novel Idea from Barbados

Not long ago the Barbados Gas Company found themselves in the position of having only one up-to-date gas cooker left in their showroom, with little prospect of meeting the demand for such appliances without considerable delay. It so happened, however, that there were available a number of "traded in" electric cookers, and when the showroom attendant jokingly suggested to Mr. J. W. Brown, the Engineer and General Manager, that these would be more useful if they were turned into gas cookers, the latter observed: "There's many a true word spoken in jest; why don't we convert them?" And shortly afterwards several of them were converted.



The only real difficulty, observes Mr. Brown, was the control of air to the oven, but tests have proved that this has been satisfactorily overcome; and consumers now have these appliances available at a reasonable cost, with a guarantee of full allowance towards the new gas cookers when they arrive should they desire to change. One of these converted cookers is illustrated here.

Other electric stoves have been broken up to provide spare nuts, bolts, &c., the side sheets making useful oven browning shelves. In addition, some of the sheets make good patches for the Company's old gasholder. In general, therefore, remarks Mr. Brown, there is not much "scrap" wasted in Barbados.

Modernization and Extensions at Greenock

New premises in connexion with Greenock Corporation Gas Department were officially opened on Saturday, Feb. 15, at 118, West Blackhall Street. A modern demonstration room has been provided, the existing showroom has been extended and modernized, while improved office, stores, workshop and staff accommodation also form part of the scheme, the cost of which is £10,000.

The new premises cover an area of 1,200 square yards, the main building being a steel-framed structure with five bays. The new demonstration room is 40 ft. by 30 ft., with a platform 16 ft. by 9 ft., heating being effected by gas radiant bowl and wall-panel heaters. In the office section is a room to be used as an Industrial Gas Demonstration Room. The old showroom now possesses an up-to-date, "live" hot water display where automatic gas-fired water boiling and heating appliances can be demonstrated with a new system of ventilation ducting and fan to make possible the demonstration of modern gas fires under actual working conditions.

Provost R. Lemmon, of Greenock, presided at the official opening and congratulated the Gas Committee on having the courage to proceed with the building under present conditions. The manufacture of gas, he said, began in Greenock 113 years ago, near the place where they were assembled that day, oil lamps being used in the streets before that time. A local newspaper of that period declared that Greenock streets were better lighted than those of Glasgow. They had been well served by their gas engineers, men like the late Samuel Stewart, James McLeod, and the father of their present Engineer and Manager, Mr. R. D. Keillor.

Councillor A. McLachlan, convener of the Gas Committee, in declaring the new premises open, said it had been absolutely necessary for them to extend. They commenced the manufacture of gas in Greenock in 1828 with a capital of £5,000, and their undertaking was now valued at £500,000. Their annual revenue was £110,000, and during the last ten years the undertaking, after paying its way, had contributed £8,000 to the General Fund of Greenock Corporation. They supplied gas to consumers at the price of 3s. 4d. per 1,000 cu.ft., which was a tribute to the ability of their Engineer and Manager, and his staff of 170.

Mr. Robert Gibson, M.P., K.C., the Member of Parliament for Greenock, complimented the Corporation on its enterprise in providing facilities for the extension of its gas services. Gas, he said, was cheap, warm, clean, and comfortable, and was an essential service that should be specially guarded in wartime.

The Board of Trade have made an Order which comes into force at once prohibiting the export to any destination, except under licence, of mobile producer gas units. Copies of the Order, S.R. & O. 1941, No. 241, are available at the Stationery Office.

A Meeting of the Central Executive Board of the National Gas Council will be held in Committee Room No. 1, Gas Industry House, 1, Grosvenor Place, London, S.W. 1, on Tuesday, March 11, at 12.30 p.m.

"Therefore we stand, all of us, upon the watch-towers of history, and have offered to us the glory of making the supreme sacrifices and exertions needed by a cause which it may not be irreverent to call sublime".

The Prime Minister.

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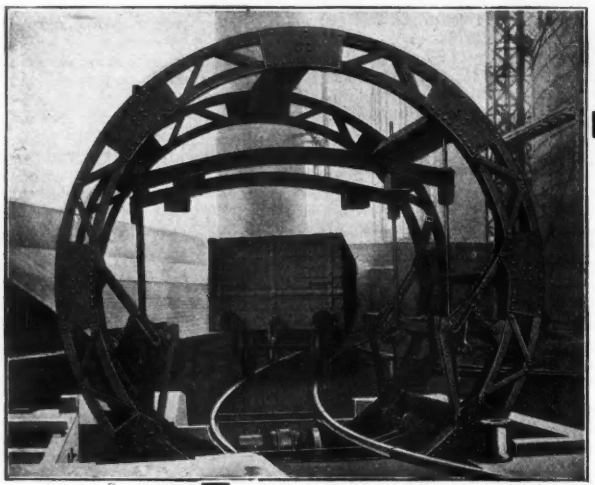
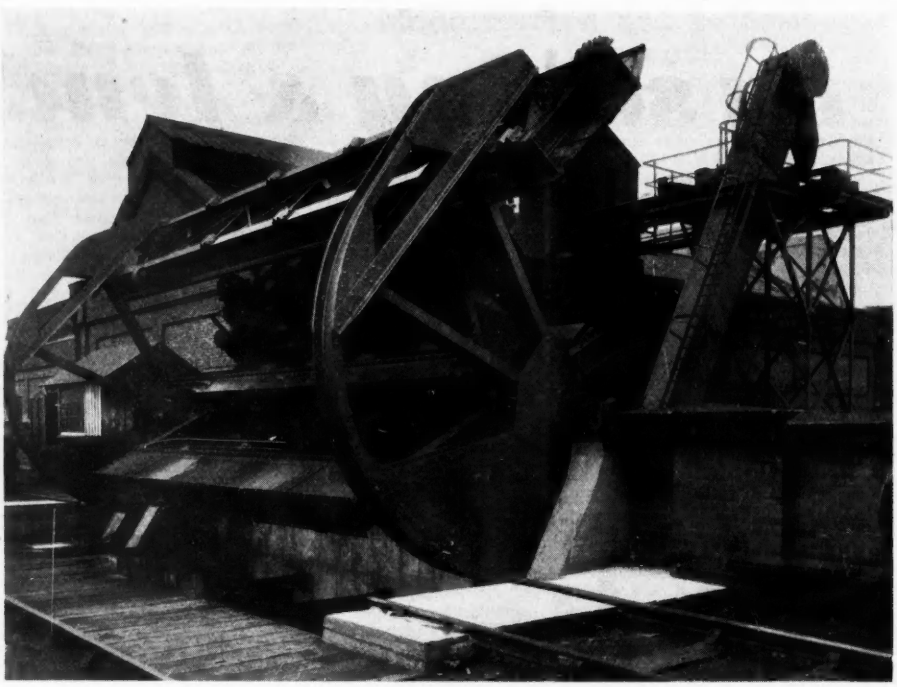


WAGON TIPPERS

The installation of wagon tipping apparatus of the mechanical type greatly increases the ease and rapidity of coal handling and storage. We design, manufacture and erect a complete range of tippers of the rotary, side, overhead, and underground types, and would be pleased to advise on any particular problem.



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INSTITUTION WRITTEN COMMUNICATIONS

We commence publication to-day of Written Contributions on Recent Blue Books of The Institution of Gas Engineers and the Gas Research Board

[Institution Communication No. 236]

Mr. **H. J. Toogood** (Hampton) wrote: There is almost a paradox in the design of this lute, for should larger cups be installed, for greater safety, then a larger volume of gas will be entrapped. Thus the scope of the designer is narrowed almost to the choice of proportions. The two fundamentals are (i) a practically constant volume of trapped gas, of an increasing pressure within the lute, and which, as the gasholder moves, displaces (ii) the limited and vital sealing medium, thus varying the seal, sometimes to the point of extinction.

Now if these two fundamentals could be interchanged, so that the vital seal became the constant, and the trapped gas the variant, then all-round advantages would accrue immediately. I therefore suggest that external equilibrium pipes be arranged to connect adjacent lutes. By this means the vicious circle is broken, and for like conditions the seal would remain relatively constant and at the maximum at all times, and the entrapped gas would become the variant, and (to the extent of pressure increase) flow into the gasholder. Such equilibrium pipes would offer no difficulty to gasfitters, and being external could receive regular attention, and they may even form part of the ladders.

A considerable benefit for the seal having been obtained for like conditions, there follows a greater latitude for the designer's art and for the embodiment of the modern refinements outlined in the Paper—namely, oil-filming, ice-removal, allowance for the action of wind, evaporation, and the sinking of foundations.

[Communication No. 2 of the Gas Research Board]

Emeritus Prof. J. W. Cobb (Leeds) wrote: One of the most interesting subjects discussed in this comprehensive Report is the action of alkalis on refractory materials, and it is also one of the first importance to industry. It is complicated, too, by the fact that, unlike most fluxes, alkali often attacks as a vapour, usually sodium chloride, and the result of the attack is so very much dependent on the thermal history, even with the same materials and the same maximum temperature. Thus, if a surface of fine-grained fireclay in a kiln or furnace is attacked by sodium chloride vapour, carried by products of combustion at a temperature of, say, 1,200°C., the formation of a fused glaze results, sealing the pores, and very little alkali penetrates below the glaze. The product is a salt-glazed brick or tile, practically unaffected except for the glazing. But if a similar surface is attacked at a lower temperature of, say, 800°C., there is a continuous penetration and fixation of alkali extending well below the surface of the mass, which retains its porous, permeable structure, and if the temperature is then raised to the same maximum temperature as before, 1,200°C., even without further supply of alkaline vapour, a honeycombed, blistered structure results, quite different from that obtained previously. This phenomenon came first to my notice in the experimental working of a continuous gas-fired salt kiln at the works of the Farnley Iron Company. It meant in that case that the gases from a high-temperature salting chamber could not be carried forwards through cooler chambers during the salting, but other similar cases will suggest themselves.* It is always to be borne in mind that a compound can be formed even by solid oxides without any sign of fusion, and the varied results of fusion may declare themselves at a higher temperature.†

Mr. **Frank West** (Friden) wrote: To be able to present such a Report as this, as the result of the work carried out during a year under which abnormal conditions have prevailed, promotes the strongest feelings of optimism for the future of research. The field covered by the investigations widens, and the energy with which the research is being directed is reflected in both the quality and scope of the Report.

In many of the investigations the information obtained is of value to both the manufacturer and the user of refractories, and must ultimately lead particularly to increased efficiency of carbonizing refractory materials.

The investigations in connexion with the production and testing of refractory insulating materials are of particular value and interest at this time, and it is pleasing to see stress being placed on the importance of standardization in the testing of such materials. This point needs constantly to be borne in mind when comparing data on different products.

Several of the Papers contain the latest results of the continued investigations on problems of long standing, but each successive Paper indicates that the continued investigation is steadily bringing nearer the solution of the problems connected with the action of gases, vapours, and slags on refractory materials and so eventually leading to improved service.

With regard to the maintained temperature refractoriness under load test, the conclusion that the present form of the test is not suitable as a standard method on account of lack of agreement between different laboratories is well worth noting.

Consideration of the progress report of other work of interest to the Gas Industry amply illustrates the care and forethought exercised in the direction of the research programme to ensure simultaneous progress in related spheres of activity.

* "Refractory Materials and Salty Coals," *Gas World*, 1916, **64** (Coking Section, April 1, p. 11).

† J. W. Cobb, "The Synthesis of a Glaze, Glass, or other Complex Silicate," *J. Soc. Chem. Ind.*, 1910, **29**, 69.

GAS UNDERTAKING RESULTS

Bristol

The Directors of the Bristol Gas Company feel that, in the circumstances of to-day, the results of the past year's trading are encouraging. During the year manufacturing and distribution costs rose materially, while local conditions restricted consumption during the latter part of the period. The Directors state that they have given consideration to both these factors in fixing the price of gas. The balance of revenue carried to Net Revenue Account is £120,859, which compares with £126,405 a year ago, while it is shown by this account that the sum available for dividend is £141,457, and the maintenance of the distribution on the general capital stock at the rate of 5% per annum will leave to be carried forward a balance of £99,776. A year ago the carry forward was £108,552.

Chester

Following upon a gratifying increase in sales of gas during 1939, the Chester United Gas Company experienced a further satisfactory gain in business during the past twelve months. The balance of revenue carried to Profit and Loss Account is £21,931, as compared with £16,458 a year ago. After making extra provision for Income Tax, and payment of a dividend on the ordinary stock of 5¼% for the year, there will remain to be carried forward a balance of £8,115, as compared with the £6,242 brought into account. The dividend is at the usual rate.

Cork

The balance of Profit and Loss Account for the half-year ended Dec. 31 of the Cork Gas Consumers' Company is £3,947, with which the Directors have decided to pay the usual dividend at the rate of 8% per annum. For the same half of the preceding year the balance was £3,277. Rental receipts are up from £51,670 to £57,930, while on the other side the cost of coal has risen from £30,791 to £43,089. The return from residuals is about £6,000 more on the present occasion than it was a year ago.

East Surrey

In their report for the year 1940, the Directors of the East Surrey Gas Company state that, while the sales of gas and coke continued to show expansion, rises in the costs of coal, materials, and labour, and increasingly heavy expenditure due to the war, have necessitated a further increase in the price of gas. The dividend on the ordinary stock is 5% for the year, as against 5⅜% for 1939. This will leave a balance of £1,406 to be carried forward, compared with the £1,147 brought into account. The cost of coal and oil, including all expenses, is up from £63,502 a year ago, to £90,261, but revenue receipts are some £40,000 more, and the balance carried to Profit and Loss Account is a little more than £2,000 up, at £40,156.

Exeter

General increases in costs made it necessary for the Exeter Gas Light and Coke Company to increase the price of gas by a halfpenny per therm from the date of the meter readings at midsummer last. There was an increase during the year in the number of customers, but sales of apparatus decreased. At the annual meeting of the Company a dividend was declared for the six months ended Dec. 31 at the rates per annum of 7½% on the new ordinary shares and 10½% on the original stock. One shareholder suggested that it would be a wise policy to postpone the dividends, and proposed that they be deferred; but he failed to find a seconder.

Gloucester

In their report for the year 1940, the Directors of the Gloucester Gas Light Company state that the balance brought forward from the previous year was £14,862. The Revenue Account shows a profit for the year of £19,364, to which has to be added interest £1,251. After deduction of interest on debentures, &c., £5,342, the net profit is £15,272. The Directors recommend a dividend for the year of 5¼% on the consolidated ordinary stock, which (with the transfer from Reserve Fund of the sum of £289) will leave a balance of £16,289 to be carried forward. A year ago the profit on Revenue Account was £19,215, and the dividend paid was the same as on the present occasion.

Liverpool

The Liverpool Gas Company are again paying a half-yearly dividend of 3% on the ordinary stock. The Directors report a total revenue for the twelve months ended Dec. 31 last of £1,634,541, and expenditure amounting to £1,425,761, leaving a surplus of £208,780 for transfer to the credit of Net Revenue Account. The amount so transferred a year ago was £170,246. Manufacturing costs are up from £828,604 to £957,326, while receipts from sales of gas show an increase from £1,103,583 to £1,233,063. In their report the Directors express regret that, owing to further increases in the cost of coal and working expenses, they were compelled to increase the price of gas from 9d. per therm to 10d. per therm as from Oct. 1, 1940.

Oxford

It was reported at the annual meeting of the Oxford and District Gas Company that, owing to the considerable increase in the cost of coal and the many extra charges which fall upon the Company in consequence of the war, it was found necessary to make a small increase in the price of gas from the commencement of the June quarter, and another from the beginning of the September quarter—the two together totalling 1d. per therm. The Directors again recommended a dividend on the consolidated ordinary stock at the rate of 10% for the whole year. Manufacturing costs are up from £165,830 to £220,144, but additional receipts have increased the balance carried to Profit and Loss Account fro m £41,885 to £54,480.

(Further results will be found on p. 430)

COMBUSTION CHARACTERISTICS INVESTIGATION AND THEORETICAL CONSIDERATIONS

By T. S. RICKETTS, *Tottenham & District Gas Company*

AN investigation into combustion characteristics was commenced in 1933, an Ott burner being employed. Although this burner proved remarkably accurate for the indication of flash-back, it was replaced later with the standard type of Aeration Test Burner.

Systematic tests were taken on the town gas and the three types of diluent gas employed—namely, producer gas, blue water gas, and carburetted water gas of varying quality. It was evident that large variations in the A.T.B. No. were occurring in the mixed gas supplied.

Coal Gas.—Owing to the high C.V. the A.T.B. No. was very high and appeared to be roughly proportional to the C.V.; the composition of the unsaturated hydrocarbons also had an effect.

Producer Gas.—The A.T.B. No. was very low, only slight variations occurring from day to day.

Water Gas.—As with coal gas, the A.T.B. No. appeared to be roughly proportional to the calorific value, but for a given calorific value is lower than that of coal gas.

Mixtures.—As already stated, the A.T.B. Nos. varied considerably, and in an attempt to find some relationship between composition and A.T.B. No. a considerable number of analyses of mixed gas were taken. Table II sets out the results of some of these tests.

F. O. Hawes has suggested that the combustible gases in town gas may be separated into two classes; those possessing the characteristics of "hard flames" when burnt—these comprise carbon monoxide and hydrogen—and those having "soft flames" on combustion; these are methane and the unsaturated hydrocarbons. These hard flame gases are practically prone to "lighting-back" tendencies and their presence to any extent in town gas encourages these properties. The soft flame gases do not possess these tendencies and assist in the steadiness of the flame.

From a comparison of the results in Table II it will be seen that these theoretical considerations are borne out in practice to a certain extent; in fact the ratio $\frac{C_n H_m + CH_4}{CO + H_2}$ can be applied with a certain amount of accuracy, but only if the individual diluent gases comprising the whole are not widely different.

If the air requirements for combustion are calculated, it will be seen that the coal gas/producer gas mixture needs more air for combustion than the coal gas/water gas mixture.

It must be emphasized that all the investigations that were undertaken between 1933 and 1936 were taken with a view to their application to works practice and were therefore kept as free from academic considerations as possible.

TABLE I.—COMPOSITION OF INDIVIDUAL GASES.

Gas.	C.V.	CO_2.	O_2.	C_nH_m.	CO.	H_2.	$C.H_4$.	N_2.	A.T.B. No.
Coal Gas	630	2.4	.4	3.8	6.8	50.8	33.5	2.3	220
Producer Gas	120	7.0	...	...	24.9	12.3	...	55.8	11
Blue Water Gas	295	5.2	...	...	39.0	49.6	0.5	5.5	16
Carb. do.	400	4.6	...	3.8	36.6	44.0	5.0	6.0	32
Carb. do.	500	4.7	...	6.9	33.4	37.8	10.0	7.2	52

TABLE II.—COMPOSITION OF MIXTURES (AVERAGE). AFTER BENZOLE STRIPPING.

	Coal Gas/Producer Gas.	Coal Gas/Blue Water Gas.	Coal Gas/Carb. Water Gas.
C.V. of Mixture	500	496	495
%P.G. in Mixture (Vol.)... ...	15.9	*Nil*	11.5
%W.G. in Mixture (Vol.) ...	*Nil*	21	18.5
CO_2	2.2	2.2	2.2
O_2	0.8	1.0	1.2
CnHm	2.2	2.0	3.4
CO	8.2	14.6	14.0
H_2	44.4	51.0	40.8
CH_4...	26.6	22.9	24.2
N_2	15.0	6.1	13.8
A.T.B. No....	78	68	73
Ratio $\frac{C_nH_m + CH_4}{CO + H_2}$	0.546	0.380	0.504

TABLE III.—ANALYSIS OF A NUMBER OF MIXTURES OF COAL GAS.

CARBURETTED WATER GAS AND PRODUCER GAS.

	1.	2.	3.	4.	5.	6.	7.	8.
C.V. Wet	503	504	498	494	496	495	492	488
C.V. Dry	508	509	503	499	501	500	497	493
CO_2...	3.1	3.0	3.0	3.2	3.0	2.8	3.2	3.2
O_2...	0.9	1.0	1.0	1.2	1.2	0.8	1.2	0.9
C_nH_m	3.8	4.4	4.0	3.8	4.0	4.0	4.0	3.8
CO	13.2	15.0	14.6	15.2	15.8	14.8	15.2	16.0
H_2	42.4	41.6	41.4	39.4	41.4	40.2	40.8	40.4
CH_4...	24.6	21.4	22.8	23.0	19.7	22.9	22.1	20.2
N_2	12.0	13.6	13.2	14.2	14.9	14.5	13.5	15.5
S.G....	0.558	0.549	0.550	0.549	0.551	0.542	0.550	0.544
A.T.B. B 19 mm. (Cone Height)	78	72	70	69½	68	67½	67	64
%C.W.G.	19.0	26.1	25.8	26.4	28.9	23.3	25.8	26.3
%P.G.	15.0	15.3	9.0	12.0	10.9	16.1	13.0	9.6
%Air	3.5	2.8	4.0	4.6	5.8	4.7	4-4	5.6
C.V. C.W.G.	516	526	560	540	545	554	525	550
C.V. P.G.	118	129	126	127	117	128	126	115
Ott No.	...	3¼	3	2⅞	2⅞	2½	2⅝	2⅜

Practical Applications of the Foregoing; Theoretical Considerations

Owing to the high CO content and low air requirements of blue water gas, it was desirable to reduce the amount added. As carburetting increased the effect was less marked. It was in an attempt to improve the $\frac{C_nH_m + CH_4}{CO + H_2}$ ratio in the mixed gas that simultaneous dilution of coal gas with producer gas and high C.V. carburetted water gas was introduced.

The effect was to increase the potential capacity of gas-making plant and also improve the A.T.B. No., and typical analyses obtained are shown in Table III. It shows the lower A.T.B. No.'s with increasing amounts of carburetted water gas and also correspondingly increasing amounts of CO. The method of working was to increase the C.V. of carburetted water gas according to the amount required and try to maintain the amount of producer gas constant.

The next step was to determine the A.T.B. No. at which appliances on the district began to fail. For this purpose a number of lighting burners were fixed in the laboratory and gas of varying composition and A.T.B. No. applied.

The critical A.T.B. No. appeared to be 68 for the majority, a decrease in efficiency being observed; at 65 they lit back. Similar tests were carried out on fixed gas orifices on appliances such as cookers, and in these cases it appeared that 64 was the lowest A.T.B. No. desirable.

With our method of working producer gas and carburetted water gas we were able to keep the A.T.B. No. of mixed gas above this figure, but as the lower limits were approached it became essential that no drop in C.V. took place. In fact with high amounts of carburetted water gas it became necessary to keep the C.V. slightly above 500.

The effect of the composition of the mixed gas on the A.T.B. No. when making different quantities of gas can be seen in Table IV.

TABLE IV.—Seasonal Variations of Gas Composition at Varying Outputs.

	A.	B.	C.	D.
C.V.	500	500	501	500
CO_2	2.6	2.4	2.2	2.6
O_2	6	4	8	8
C_nHm	2.4	2.2	1.8	3.4
CO	9.0	13.0	14.8	16.6
H_2	42.6	43.2	50.8	44.6
CH_4	26.0	26.9	23.6	24.7
N_2	17.4	11.9	6.0	9.3
S.G.	0.535	0.521	0.475	0.520
$\frac{C_nH_m + CH_4}{CO + H_2}$ ...	0.557	0.518	0.387	0.459
A.T.B. No.	80	74	66	68
Output, cu.ft. ...	500,000	600,000	580,000	730,000
%P.G.	17	14	*Nil*	8
%B.W.G.	*Nil*	9	22	*Nil*
%C.W.G.	*Nil*	19 (C.V. ... 430)	*Nil*	30 (C.V. = 430)
%Air...	4	4.5	4.0	4.5

Test A shows a typical coal gas/producer gas analysis with usual high A.T.B. No. giving a satisfactory flame on combustion.

Tests B and C show two different compositions of gas made when holding outputs of 600,000 per day. When diluting with producer gas and carburetted water gas (Test B) the A.T.B. No. can be held at 74, but when all blue water gas is used the A.T.B. No. falls to 69, and an increase in the CO content of the gas is observed.

Test D shows the composition of the gas when making over 700,000 per day. By adjusting the composition with producer gas and carburetted water gas we were able to hold the A.T.B. No. at 68.

The experience gained by the results of these tests amply proved to us that although we had found the means to reduce complaints from the faulty combustion on the district to a minimum, we could improve the stability of the flame in the burner considerably if we could replace carburetted water gas with producer gas, which of course returned us to the starting point, that of increasing the output of coal gas.

TOWN GAS FOR SPECIAL ATMOSPHERES *

RESULTS OF AMERICAN INVESTIGATION

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TOWN gas is so familiar to all of us that we may think of it only as the fuel that keeps our bunsen burners or our kitchen stove going so conveniently. Actually it is not so simple a fluid, nor is it identical in composition in each of the burners from which it flows.

More than 30 different types of fuel gases are commercially sold and used throughout the United States but in each locality they are just "city gas." Thus, to the individual, used only to his own gas, there seems but little unusual about it, although it really may be a most extraordinary chemical agent. Typical gas analyses are given in Table I. They vary in composition from 100% hydrocarbons to mixtures containing principally carbon monoxide and hydrogen, while still others are air-gas mixtures with only 17% combustible by volume.

It should occasion no surprise that the application of these many gases to the problems of the chemist and metallurgist have progressed far beyond their use as fuels. They have attracted attention from potential users with many different requirements for special atmospheres with which to surround their products, and even as raw materials for the modification of metals and the starting-point for organic syntheses.

Generally speaking, when a gas has been located to meet some special needs it may also be successfully applied for heating the process, furnace, or oven in which the special atmosphere was also a requisite. This flexibility, providing both fuel and atmosphere, has become a predominant industrial factor only within the last decade. Formerly, the limit of special atmospheres was the degree of adjustment which was obtainable by manipulating burner control valves, and these results were expressed by the old text-book terms oxidizing, reducing, and neutral atmospheres. Their definition, so simple to those who coined the terms, now eludes us as completely as a buzzing mosquito on a summer night.

For convenience the words are still used to classify types of atmospheres, but they have lost much of their significance as metallurgical or chemical factors. We define them as follows:

"An oxidizing atmosphere is one in which oxygen concentration exceeds 0.05%, and the sum of CO and H_2 is below 0.05%.

"A neutral atmosphere is one in which the sum of CO and H_2 is not more than 0.05% and the oxygen is less than 0.05%.

"A reducing atmosphere is one in which the sum of CO and H_2 exceeds 0.05% and the oxygen does not exceed 0.05%."

Oxidizing atmospheres produced by large amounts of excessive air in the combustion products were long known to be required for the baking of cores, the drying of synthetic enamels, and for many phases of ceramic work. Reducing atmospheres containing free hydrogen and carbon monoxide as well as some of the hydrocarbons were well established years ago in a limited way for the reduction of metals from their ores, and were known to be helpful in minimizing scaling of steel, oxidation of copper, &c. Such atmospheres were also used to produce the crinkle effect of certain enamels. The results were satisfactory within the limits of older manufacturing specifications, but they were inadequate in terms of modern demands.

Even the older nomenclature has given way and the terms, oxidizing, neutral, and reducing are being replaced by more descriptive names which indicate the effect upon the products, as, for example, scaling, carburizing, decarburizing, nitriding, bright annealing atmospheres, and so on. Of course, this process has been one of gradual evolution, developing from the use of individual gases like H_2 or ammonia which had been in use for many years. The real strides in the application of special atmospheres seem to date from about 1932.

* Presented before American Chemical Society.

TABLE I.—Percentage of Combustible Constituents in Unburned Gases.

		Blue Water Gas	Carburetted Water Gas	Coke Oven Gas	Anthracite Producer Gas	Refinery Gas	Natural Gas Wet Type	Natural Gas Sweet Type
CH_4	Methane	1.3%	8.1%	29.6%	1.0	41.6%	87.0%	73.1%
C_2H_6	Ethane	.0	1.3	1.3	.0	19.2	4.1	23.8
C_3H_8	Propane	.0	.3	.1	.0	17.0	2.6	.0
C_4H_{10}	Butane	.0	.0	.02	.0	8.5	2.0	.0
C_2H_4	Ethylene	.0	6.7	2.5	.0	4.0	.0	.0
C_3H_6	Propylene	.0	1.5	.3	.0	5.3	.0	.0
C_6H_6	Benzene	.0	1.3	.6	.0	.0	.0	.0
H_2	Hydrogen	47.3	37.4	56.7	17.7	1.4	.0	.0
CO	Carbon Monoxide	37.0	35.0	5.7	23.2	1.6	.0	.0

Balance to make 100% principally N_2, CO_2 and minor impurities.
Also note light oils and their constituents—aromatics, higher paraffins, cyclo-paraffins, unsaturates, mercaptans and the N and O compounds.

Fostered by the demands from the automobile industry for a high degree of perfection of sheet steel for deep drawing of one-piece bodies, the special protective atmospheres assumed new importance. The rapidly growing interest in bright finishes added impetus to the spread of their use. Before long there was a rush to use special atmosphere machines which sometimes were unwarranted for the particular application, but the setbacks only served to clarify the methods, and their history has been one of rapid spread and improvement, made possible by co-operation between equipment manufacturers and industrial gas engineers with the metallurgists and production men in industry.

As far as metal heat treating is concerned the special atmospheres have made possible three accomplishments which have all but revolutionized metal manufacturing: first, clean heat treatment of low carbon steels (and non-ferrous metals as well); second, bright hardening of medium and high carbon steels without any surface oxidation or decarburization; and third, bright treatments for high carbon and alloy steels. Naturally these classifications overlap and a given steel may be successfully treated in more than one type of special atmosphere depending on the time and temperature of the process. Protection given by the gases surrounding metals is a function of several variables, and what may be inert in one instance may be active in another. Nitrogen is typical of such action, and may be unsatisfactory for certain metals in spite of its so-called chemical inertness.

In these applications of special atmospheres we are dealing with attempts to prevent the interaction of the metal with any of the gases surrounding it, except possibly the reduction of scale to the free metal. There is, on the other hand, an equally important application of special atmospheres, in which direct interaction with the metal is desired. Perhaps the best example of such work is the application of special atmospheres for gaseous carburizing.

In a similar way it is possible to classify these special atmospheres for chemical applications such as the inert atmospheres for fire protection or for purging of combustible gases for storage vessels of various sizes.

General Methods for Special Atmospheres

The particular use will indicate the required individual characteristics in the atmosphere which will produce the desired result. It might, therefore, be helpful to tabulate the general methods of producing the special atmospheres and to indicate their principal applications. There are nine general methods in current use, two of which are not strictly special atmospheres but they have been included for the sake of completeness. There are more than twenty manufacturers of national reputation building the machines for producing these various gases.

The nine general methods of producing these protective heat treating atmospheres include:

1. **Purified Partially Burned Gases:** I have already mentioned the principal application of this type of atmosphere for annealing low carbon steels. It is also applied to the annealing of copper tubing, wire, and for hardening some of the S.A.E. steels. Within its limitations a prospective atmosphere of this type is better than direct heat in most instances. It is hard to discuss this subject without having these reservations constantly in mind; time and temperature are vital points to consider in generalizing on the effect of an atmosphere. It must also be remembered that the atmosphere gas entering a furnace and leaving a furnace may be quite different.

2. **Cracked Gases:** The cracked gases are very much higher in B.Th.U. content and in reducing constituents. They have special application for carburizing and for heat treating certain high carbon steels. This is the type of atmosphere which would undoubtedly have an important application for chemical reduction processes.

3. **Cracked Liquid Ammonia:** The principal application, up to the present time, seems to be in the stainless steel field and for fabricated parts which can justify this relatively high-cost atmosphere. It can be modified in various ways to produce any desired nitrogen concentration.

4. **Pure Nitrogen Atmospheres:** A great deal could be said about atmospheres of this character which, theoretically, are neutral to most materials. Practically, it is hard to keep the nitrogen from becoming contaminated in one way or another. The most promising commercial possibilities lie in producing nitrogen in a generator using gas as a raw material and then removing all oxygen, carbon dioxide, and water, leaving some carbon monoxide, hydrogen, and methane behind. Broadly speaking, nitrogen atmospheres are best where the neutrality act is desired. They are not so good where a little favouritism must be shown to one side or another.

5. **Treatment of Natural Gas with Steam and Air Followed by Removal of Carbon Dioxide and Water:** Developed for the production of atmosphere with high carbon monoxide, hydrogen, and nitrogen content. The chemistry of producing this type of atmosphere can work in reverse. Hydrogen easily reacts with CO_2 to produce water. This can ruin the effectiveness of expensive dryers.

6. **Cracked Methanol:** Protective for the shorter treatments, but is decarburizing in its action for the high carbon steels. This action has been noted by many observers, and is one of the principal reasons why pure hydrogen, which can be and is being effectively used for certain work, is not recommended for the higher carbon steels.

In all of these methods of producing special atmospheres, it is hard to keep traces of moisture out. It is all too easy for oxygen to enter and, if hydrogen is present, then water is also. Oxygen gets in by many ways. It creeps in through wash water, through extracting solutions, by leakage and so on. The water so produced is practically impossible to eliminate and is generally troublesome.

7. **Charcoal Producer Gas:** It is a type of atmosphere which has been very popular in Europe and has now been introduced to this country for the tool steels, molybdenum steels, &c. As in the previous types, the question of water vapour is important, and some of the latest units preheat the charcoal to purify it before producing the atmosphere gas.

8. **Protection by Coating:** Various methods have been tried, such as copper plating, coating with lithium carbonate, coating with various porcelain frits and glazes. All the methods have certain objections but the idea should be encouraged, as it is definitely satisfactory procedure and would permit the use of direct-fired gas furnaces. Possibly, these coatings would have their greatest value in plants where it would only be occasionally necessary to heat treat with protection. In such circumstances a prepared atmosphere furnace might not be justified, and the coating would do the trick.

9. **Vacuum Furnaces:** Practically unknown in this country, vacuum furnaces are used in Germany and, to some extent, in England, but they do not give the perfect results that you might expect. It is difficult to keep out traces of air, and the vacuum seems to accentuate the action of oil films left on the work—something that must not be overlooked in all special atmosphere furnace practice.

In order to apply these methods in practice, it was first felt that scientific work would lead to a definite statement regarding the composition of a given atmosphere; but in practice other variables require consideration, particularly time and temperature, making it impossible to lay down hard and fast rules for the composition of a given process atmosphere. Table II is illustrative of the typical protective atmospheres in actual use at present. These are largely partial combustion atmospheres supplemented by purification, removal of CO_2 and dehydration, as required.

The essential part of machines for this purpose are:

A. Gas burner permitting the control of the air gas ratio at fixed levels.

B. Suitable combustion space with catalyst when required.

C. Washer and cooler intended for removal of some of the water vapour produced and for cooling the gas: This may also remove some CO_2, SO_2, and SO_3, although the low partial pressure of these constituents makes the complete removal doubtful unless the water wash contains appropriate chemical absorbents. An oxide box is often of advantage with manufactured gases as it is not expensive, and offers a factor of safety if the mixture is richer than normal. The removal of CO_2 and addition of some CH_4 or its equivalent is of benefit in overcoming any decarburizing tendency. Care is necessary not to reintroduce oxygen through the water, or by leakage.

FERRODOR
METAL PROTECTION

FOR

PROTECTING

GAS HOLDERS

AND OTHER

STRUCTURAL WORK
FROM THE RAVAGES OF CORROSION

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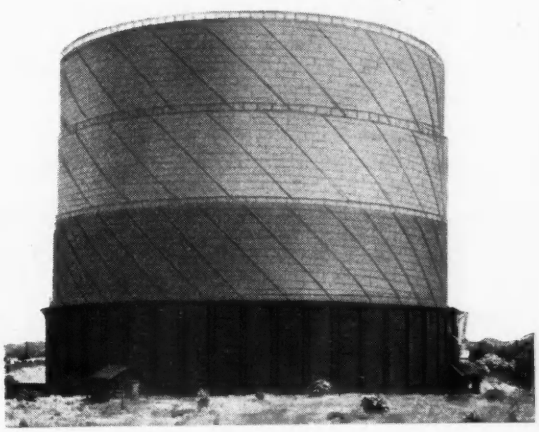

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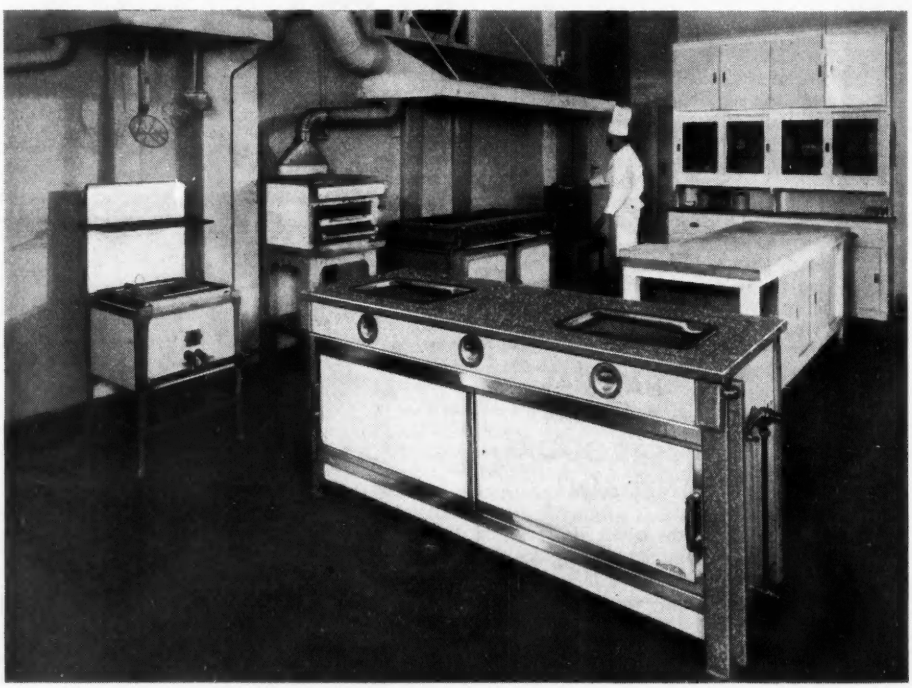

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Water Heaters, etc.

LARGE – SCALE EQUIPMENT

TABLE II.—Typical Protective Atmospheres Produced from Gas.

Source.	Air-Gas Ratio	H_2	CO	CO_2	CH_4 + C_2H_6	N_2	Furnace Temperature, °F.	Retort Temperature, °F.
Natural gas (partial combustion) ...	6 : 1	9.6	8.7	5.8	1.9	74	...	...
Natural gas (processed after combustion)	9 : 1	1.1	2.8	0.0	0.5	96	...	...
Manufactured gas	2.8 : 1	13.9	5.8	9.5	0.0	70.8	...	...
Natural gas* as applied to the following operations :								
Annealing copper tubing	8.5 : 1	1.5	1.5	10.7	...	...	1150	2000
Annealing steel sheets	6.5 : 1	13.6	9.6	5.7	...	...	1300	1600
Annealing copper wire	8.5 : 1	1.5	1.7	10.7	...	...	800	1800
Hardening axle shafts	3.0 : 1	...	11.1	3.0	...	...	1550	1800
Hardening light springs	6.0 : 1	14.0	11.2	4.6	...	...	1550	1600
Copper brazing of tubing	5.5 : 1	13.2	10.4	4.8	...	...	2150	1600
Inflating tire mold bags	9.0 : 1	0	0.5	10.8	...	...	Cold	2000
Protective gas in making synthetic varnishes	9.0 : 1	0	0.5	10.8	...	...	Cold	2000
Charcoal gas (not purified)	...	2	29	3	0.5	65	...	...

*Note.—This natural gas contains 1006 B.Th.U. per cu.ft. and is made of: CH_4 70%, C_2H_6 17%, N_2 11%. The results show that these protective atmospheres are established for each operation in accordance with the best esults. Atmosph ere generator practice is not yet standardized.

D. Dryer: The effect of even small quantities of water vapour may be very marked, and various dryers are used to reduce the moisture content to levels below those at which the work will be affected. Principal equipment employed for this purpose includes refrigeration, adsorption by silica gel, or by activated alumina. Washing eliminates carbon and dust.

The resultant gas is non-explosive if the B.Th.U. value is kept below 50 B.Th.U. per cu.ft. Precise analyses of the composition of the hot gases in a furnace are difficult to make, and O_2 is likely to be present in small quantities (0.05%) even in the presence of large excesses of combustible.

When richer gases are required the unburned gas is heated in closed containers maintained at temperatures higher than that at which the gas is ultimately to be used. The operation is carried out in the presence of a catalyst such as coarse iron turnings and steam and/or air added to assist in the removal of free carbon produced from the pyrolysis of hydrocarbons in the original gas. The principal reaction in the case of methane is:

$$CH_4 \rightleftarrows 2H_2 + C$$
$$C + H_2O \rightleftarrows CO + H_2$$

The carbon precipitated may be removed by filtering or washing, if necessary. It has been noted that the life of an iron tube is shortened when temperatures over 1,500° F. are used, but that substitute alloys do not yield quite as good results. Heathcoate is credited with the following formula for determining the size of tubes needed:

$$\text{Length in feet} = 1.75 \sqrt{\frac{\text{cu. ft. of gas per hour}}{(\text{Diam. of tube in inches})^3}}$$

The cracked gases are higher in B.Th.U. content than those from partial combustion and may be in the explosive range, thus requiring care in handling.

TABLE III.—Typical Results from Cracking of Gases.

Source	H_2	CO	CO_2	$CH_4+C_2H_6$	O_2	N_2
Manufactured gas	54.2	7.0	1.8	30.4	1.6	5.0
Manufactured gas	42.7	10.0	1.7	27.3	0.5	17.8
Natural gas ...	28.0	14.0	3.0	7.0	0.0	48.0
Natural gas ...	32.0	15.0	0.3	12.0	0.0	40.7

Safety Note.—Since a great many atmospheres use large quantities of toxic constituents, such as carbon monoxide, every precaution possible should be taken to ensure the removal of such gases around the furnace. They must not be allowed to contaminate the air in the room. This may require ventilating hoods at loading and unloading ends, if not over the entire furnace. Extreme care is also necessary to avoid explosive mixtures. Leaky furnaces may be dangerous as explosion hazards as well as health hazards.

Since some of the special gases are expensive to produce, it is necessary to employ tightly constructed furnaces so as to reduce loss by leakage. It is also important to provide for continuity of service and for the removal of the various adsorbing, purifying, and washing agents without interfering with successful production of the atmosphere gas. Table III shows the analysis of cracked gases.

Purification of Special Atmospheres

The very term "special atmospheres" which has been applied in this Paper denotes purification of the normal gaseous products, both burned and unburned, to produce certain specific results. In general, five processes are employed to purify partially burned and cracked atmospheres as follows:

1. **Condensation or Washing:** Water is generally used in a suitable washer-scrubber tower to condense the atmosphere and cool it. If necessary, solutions to remove CO_2, SO_2, and SO_3 may also be employed. Condensation removes moisturedown to the vapour pressure of the cooling water, but for certain processes this is insufficient, and further water removal methods are applied.

2. **Chemical Purification:** Chemical removal of the acidic constituents is applied when necessary, as for example the removal of CO_2, SO_2 by the ethanolamines (Girbitol process). The removal of hydrogen sulphide is the most important consideration and is briefly outlined in the following section:

(*a*) Removal of H_2S: The removal of H_2S, produced during gas preparation, follows similar methods in regular gas-works purification practice. The gas is passed through a mixture of iron oxide and wood shavings or other bulky inert material. After the oxide has become fouled —(*i.e.*, converted to iron sulphides)—it can no longer absorb H_2S and must be replaced or revivified by moistening and spreading in the open air. In special atmosphere units, the amount of H_2S to be removed is substantially smaller than in the purification of raw gas. Consequently the oxide boxes for special atmospheres have a long useful life and are inexpensive to maintain. Removing fouled oxide is obviously disagreeable, and proper provision for ventilation is necessary to avoid hazards from H_2S. Openings to the boxes should be full size to facilitate this work. The well-known Steere Engineering Company formula for sizing these boxes is often used although it will result in rather liberal capacity.

$$\text{Area of box in sq.ft.} = \frac{0.16 \text{ (cu.ft. of gas per hour)}}{\text{Depth of layers in ft.} + 4^*}$$

* For 2 box series; 8 for three box; 10 for four box series.

3. **Absorption and Adsorption:** Absorption and adsorption methods are principally applied to the removal of water vapour below cooling water levels. The removal of organic sulphur, present in the form of CS_2 or C_2H_5S and similar compounds, by activated carbon has been tried with moderate success.

4. **Refrigeration:** This is principally applied as an alternative method for the removal of water.

The degree to which various constituents are removed with commercial equipment is shown in the following list:

H_2S—Completely removed. Traces can be removed by hot copper turnings.
CO_2—Completely removed.
SO_2—Completely removed.
SO_3—Completely removed.
H_2O—Down to vapour pressure of cooling water. Activated alumina will reduce to 0.01% or —40°F. dew point.
H_2O—(Refrigeration) down to dew point corresponding to refrigeration temperature.
H_2O—(Adsorption) down to vapour pressure of adsorbent. Relatively simple dew point methods are available which will permit determining of the moisture content of furnace atmospheres. If these are not applied, the analyses will be on the dry basis. Dew point methods will be found in Stack and Hotchkiss.*
O_2—Down to 0·05%. Easily reintroduced. Traces removable by hot cast iron borings.
NO—Controllable but not present in quantities which appear to be troublesome for furnace operation.
Dust—Not generally present but removable by filtration to particles of around 10μ size.

Experimental Limits of Partial Combustion

Review of the ample literature on combustion soon reveals that once the experimenters reached perfect combustion conditions, they practically ceased further investigation. A few bolder workers attempted to predict ratios of H_2 and CO which might be expected if the air supply were restricted, but their information was incomplete. Contrariwise, the expansion of inert atmosphere generators has yielded much data on the actual results obtained for a particular furnace operating in a specific manner with little effort being made to show the effect of each of the various factors involved.

* *General Electric Review*, February, 1938, pp. 106-8; *Metal Progress*, April, 1937, pp. 375-9.

(*To be continued in a forthcoming issue*)

Cambridge University and Town Gas Light Company

Report of Annual Meeting

A further increase in the output of gas was reported at the annual meeting of the Cambridge University and Town Gas Light Company on Feb. 21, when a dividend for the half-year at the usual rates was approved.

Mr. J. F. Cameron (Chairman of Directors) presided, supported by Mr. F. J. Dykes (Vice-Chairman), Major H. McCombie, Mr. H. T. Wing and Mr. Guy Dale (Directors), Mr. W. R. Elworthy (Auditor) and Mr. J. Hunter Rioch (Engineer and Manager).

The report of the Directors stated that an interim dividend at the usual rates, less income tax, was paid in August, and the Directors recommended the declaration of a dividend at the same rates, less income tax, for the half-year ended Dec. 31, payable on Feb. 22, making a total dividend paid for the full year to Dec. 31, 1940, of 10% on the Consolidated Original Stock, 7% on the Consolidated "B" Stock, and 5% on the Consolidated "C" Stock.

Since the outbreak of war, up to the end of the year, over £8,000 has been expended on air raid precautions and defence works.

The number of consumers at the end of the year was 27,938, made up of 14,220 ordinary and 13,718 slot consumers.

THE CHAIRMAN'S ADDRESS

The CHAIRMAN said: As you will see from a statement which follows the accounts, our make of gas has exceeded the make for 1939 by 2½% although there has been no public lighting, which usually accounts for 9% of our output.

To meet the load on our distribution system it has been necessary to extend the high pressure main and to install a new governor in the Girton area and this has had the desired effect. The policy of renewing and enlarging the mains which we took over eight years ago at Cottenham has been continued and there is now only a very small section of the old mains left. A further extension of the high pressure mains is contemplated in the Fulbourn area, and this, as well as other enlargements of the mains, will be proceeded with as soon as the Board of Trade sanction the carrying out of this work.

The new carbonizing plant has been in operation throughout the year and has given eminently satisfactory results, and, as far as it is possible to say at this early stage in its life, it fully justifies the selection of this new type of plant. It was finally taken over by us at the end of July, and since than it has been operated entirely by our own Staff. It has proved easy to control and remarkable in its flexibility to meet the requirements of gas and coke production. Under test the plant has given the remarkable yield of 96 therms of gas per ton of coal.

In the early part of the year, owing to keeping our old horizontal retort house in operation until the new plant had proved itself, our coal consumption and coke production reached new records. Coal supplies caused some anxiety at a time when stocks were reduced to a very low figure, but these have now been made good and we are in a much better position than a year ago. In order to cope with the extra work necessitated by building up stocks of coal during the summer we have added materially to our mechanical handling plant.

The installation of new auxiliary plant at the works which commenced last year has been continued and now includes a new exhauster with connexions, providing an alternative route between the retort houses and the purification plant.

The normal overhaul and reconditioning of the plant at the works, which is necessary to keep it in good condition, is being carried out as usual in spite of difficulties in obtaining materials and labour. Improvements have also been carried out, and 1940 has seen among other things the completion of a capacious new messroom with lavatories and washing facilities for the workmen.

Our largest electric generator has been reconditioned after 16 years of nearly continuous running, and is now installed in what will be developed later into a new power house, from which a completely modernized system of cables will carry power to the various sections of the works. By-product plant has been extended by an enlarged benzole extraction plant, which in a full year will considerably increase our production of this valuable product.

A contract was placed in July for a new tar plant of the latest design and having double the capacity of the previous one, which had become out of date and inadequate. It is anticipated that the plant will be in operation in the early spring. A barrel washing plant and cooper's shop have been completed, making it possible to send out our tar in barrels as clean as the traffic in tar permits.

It is natural that on the distribution side progress has been retarded. Depletion of the sales staff, due to the needs of the armed forces, increases of prices, the purchase tax, slow deliveries, together with the disappearance of private building, have all contributed to the difficulties of this section of the Company's activities; nevertheless, the sale of appliances has been fairly well maintained.

A new feature has been the equipment of communal kitchens, canteens, and welfare centres, with large scale cooking and water heating apparatus. The Home Service section is actively co-operating in the Food Ministry's National Food Education Campaign, collaborating with the local Education Authorities in this respect.

Rising costs of wages and materials necessitated an increase in the price of gas from the end of the June quarter, but at the same time it was found possible to introduce an optional two-part tariff, consisting of a fixed charge and gas at "half price." The response to this has been satisfactory, nearly 10% of our customers, to their benefit, having adopted this method of purchase. To encourage the further use of the method your Board have decided to charge no rent for a primary meter in future to those who adopt this two-part tariff.

Air Raid and Defence Precautions continue to involve us in considerable expenditure, due not only to the extension and consolidation of our shelters, but to the tightening up of the effectiveness of our blackout and anti-glare measures at the works, a task which has been a formidable one. You will be glad to know that the authorities have congratulated us on the result.

A very large amount of time is given voluntarily by the Company's employees in various capacities to meet wartime requirements, such as A.R.P. services, Fire Watchers and Home Guards, and the Directors greatly appreciate the way in which this time is given. Not the least important of these is the Home Guard, of which we have a platoon of some 165 men. These men are all doing essential work in the production of gas and by-products. Their Home Guard duties are for the protection of the Company's Works, since it is essential that they shall be available to carry on the Company's normal work.

The Company's Voluntary Organizations are extensive, and there are few of our employees who are not doing duty in at least one of them, and the Directors feel that the Company's interests are well served by them. A number of men sleep at the works every night in order to be available instantly if an emergency arises requiring their services. For some four months loss of working time due ot air raid warnings has been reduced to a very low figure, due to the working of a scheme agreed between the management and the workers, with a Committee to watch the men's interests. A "spotter" is on the works continuously day and night in order to send the men to shelter if danger becomes imminent. A similar system has been in force at the Sidney Street offices since December. Further steps have been taken to safeguard and control our mains system should an emergency arise, and both the Works and Head Offices are well equipped with fire fighting appliances and well trained squads.

The war has imposed much additional work and responsibility on all grades of the staff, who have successfully coped with many difficulties, and their loyal co-operation is greatly appreciated, and when I refer thus to the work of our men at home I am sure you would not wish to forget the men who have left us for one or other of the Services in I know not what part of the world. There are now 49 of them and one has already given his life for his country. It will be a happy day for us as well as for them when we can welcome them home.

The Accounts

I now turn to discuss some of the figures shown in the accounts. The increased cost of coal and the increased receipts for gas sold follow from what I have already said and there are increased receipts also from our by-products, coke, tar, and benzole. About one of these —coke—I would say a word. The price of coke has been subject to recent advances. I want to explain that this does not mean that your Board are using an opportunity of getting what they can. The price is not fixed by them. It is fixed in London under the supervision of the Mines Department, which regulates prices by areas over the whole country. We are for this purpose in the London area, and under the existing war conditions it is that, and not a decision of your Board on the matter, which determines the price.

I have already referred to our air raid and defence precautions. I now come to their finance. In the balance-sheet for 1939 there appeared an item, "Suspense Account A.R.P. £4,277." That sum had been spent by the end of 1939 but was not then brought to account as we knew that some part of that expenditure would be borne by the Government, but we did not then know what part. The figure to the end of 1940 (including the 1939 figure) comes to £8,410, towards which we have received £1,646 from the Government. Of the remainder, £2,555 has been charged to the Reserve Fund with the approval of the Magistrates as the Acts governing us require, and £4,207 to the Revenue Account. These are large sums, but it would be false economy not to take every protection against risk that we reasonably can.

We are again able to pay £20,000 to our Contingency Fund, against which is charged the final payments for the new retort house and the cost of the new mess room and of the new benzole plant. The money in this fund will be wanted when the war is over for various improvements not possible under present conditions.

Then there is income-tax. We pay in the now current financial year 1940–41 on the profits of our 1939 accounts. Next year we shall pay on the accounts now before you. As we shall then have to pay a higher rate on a larger sum than now without the benefit of some adjustments in our favour which affect the present payment, we have set aside a sum as an Income-Tax Reserve instead of leaving the whole brunt to be borne by future profits which will have their own burdens to bear, and may not be so well able to bear them.

I have been talking of the present and of the future, but I would not forget services rendered in the past. Mr. A. E. King died within a few weeks of our last annual meeting. He had been Secretary of the Company for over 40 years. During that long period he was closely connected with all its affairs, and he saw it rise under ever-changing conditions from a relatively small business to the position it now occupies. He was throughout deeply devoted to the interest of the Company and I would pay a tribute to his memory.

Mr. Rioch has been appointed Secretary to succeed him. The necessary secretarial assistance is given inside our own office and we find that the new arrangement works well. In dealing with our A.R.P. arrangements and similar matters I mentioned no names—nor indeed would it be possible here to give mention to all who deserve it. But Mr. Rioch occupies a special position. The present emergency has put special duties and responsibilities on him. Not only has he to do all that commonsense and technical knowledge can suggest for the continuation of the services we render, but he has to do so in conformity with the shower of Statutory Rules and Orders that now descend upon us. He has recently been appointed Honorary Gas Engineering Adviser to the Eastern Regional Commissioner. It is gratifying to us, as I hope it is to him, that he has been selected for this responsible post, and if at times the work attached to it proves to be arduous—as it well may—I am sure all of us would wish to do what we can to make things easy for him at this end.

I now move that the Report of the Directors be adopted and that final dividends be paid at the rate of 5% on Original Stock, of 3½% on "B" Stock and of 2½% on "C" Stock, subject to income-tax.

Mr. Dykes seconded the adoption of the report, which was approved, with the dividends as recommended.

The retiring Directors, Mr. Dykes and Mr. Wing, were re-appointed, as was the Auditor, with tributes for their services.

A vote of thanks to the Directors and the staff was proposed by Mr. Elworthy (who mentioned especially Mr. Rioch and Mr. Bradford) and carried with acclamation.

Gas Undertaking Results

Reading

The Directors of the Reading Gas Company report that, while the revenue from the sale of gas and residuals during 1940 shows a satisfactory increase over that of the preceding year, the cost of coal and other charges connected with manufacture and supply have greatly advanced, which necessitated an increase in the price of gas from the December meter readings, 1939. The dividends on the 5%, 5½%, and 6% maximum ordinary stocks are again at the statutory rates. The balance of revenue carried to Profit and Loss Account is £43,161, which compares with £32,024 in 1939; while the balance of net profit to be carried to next account, subject to the past half-year's dividends, is about £250 up, at £58,362.

Romford

In comparison with the preceding year, a reduced sale of gas equivalent to 3.09% has been experienced during 1940 by the Romford Gas Company. The Directors remark that, while war conditions created many difficulties, these were surmounted and the continuity of the supply was maintained throughout. In spite of every effort to keep the price of gas at 9.5d. per therm, rising costs compelled the Board to give notice of an increase of 0.7d. per therm as from the meter readings for the Christmas quarter, 1940. The dividend on the ordinary stock is again at the rate of 8% per annum. The balance to be carried forward will be £5,405, as against the £7,102 brought into account. Under the Company's Act, the sum of £5,005 10s. has been applied out of the profits for the year for the benefit of the employees. The Board conclude their report in these terms: "The Directors desire to place on record their congratulations to Mr. John Grayston, Engineer, and Mr. B. V. Poole, Shift Foreman, upon the honour which has been conferred on them by His Majesty the King in awarding them the George Medal in recognition of their gallantry. They also desire to express appreciation of the services rendered by those who were associated with them in the splendid work carried out under exceptional circumstances. It is felt that the stockholders would desire to associate themselves with this expression of appreciation for services performed in great danger in the interests of the Company and the community, with complete disregard on the part of those concerned for their own personal safety."

Scarborough

The Directors of the Scarborough Gas Company report a net profit for the year 1940 of £10,282. Payment again of a dividend at the statutory basic rate of 5% on the consolidated and new ordinary stocks will leave to be carried forward a balance of £240, which compares with the sum of £64 brought in. The sale of gas during the year amounted to 2,292,240 therms, as against 2,835,761 therms in 1939. Of this reduction, nearly 200,000 therms was due to the loss of public lighting. Application was made to the Board of Trade for an Order under the Special Enactments (Extension of Time) Act, 1940, extending by three years the time limited by Section 7 of the Scarborough Gas Act, 1932, for the promotion by the Company of a Bill in Parliament giving an opportunity for the amount of the basic price prescribed by the Scarborough Gas (Consolidation) Act, 1927, to be revised, and the Order was made last September.

Sheffield

In their report to the shareholders, the Directors of the Sheffield and District Gas Company state that the quantity of gas sold for domestic and industrial purposes during the past year was 12,993,387,000 cu.ft., which is an increase of 1,358,468,000 cu.ft. over the sales of the preceding twelve months. In addition, bulk supplies of 792,417,000 cu.ft. have been sold to neighbouring gas undertakings. This makes a total increase of 1,521,091,000 cu.ft., or 12.4% on the sales of the previous year—the whole output for the year being 13,785,804,000 cu.ft. It is pointed out that during the year the Company have acquired the undertakings of the Eckington and Mosborough Gas Company, Ltd., and the Killamarsh Gas Light and Coke Company, Ltd. These undertakings were purchased as from June last, and the accounts now presented include the profits of the two concerns for the past half-year. The price of gas has remained at 7d. per therm for small quantities, with big reductions (according to quantity) to large consumers, ranging down to 2.575d. per therm. A dividend of 6½% for the year will leave to be carried forward the sum of £120,547. Last year the dividend was the same, with a carry forward of £96,029. At the meeting the stockholders will be asked to confirm the appointment of Mr. Ralph Halkett (General Manager) as a Director of the Company.

Sleaford

At the recent annual meeting of the Sleaford Gas Company, Ltd., a dividend of 10% for the past year was agreed to. Mr. S. Hands, the Engineer and Manager, was elected an additional Director.

Wolverhampton

In view of existing circumstances, the Directors of the Wolverhampton Gas Company have deemed it desirable to issue the accounts for the past year in an abridged form, comprising a Profit and Loss Account and a General Balance Sheet. The net profit for the year, after payment of interest on the debenture stocks and allocations to the Special Purposes Fund, Renewals Fund, and Staff Pensions Fund, is £16,691. A year ago, after payment of interest on the debenture stocks, &c., and contribution to Pensions Fund, the net profit was £19,582. A dividend for the year of 7% on the consolidated ordinary stock (the same as before) will leave a balance of a few pounds to be carried forward.

Gas Radiators

Patent Specification No. 532,518 (application date, May 24, 1939), taken out by Cannon Iron Foundries, Ltd., R. T. Clayton, W. E. Benton, and A. F. Oatley relates to gas radiators. The invention consists in a chamber arranged above a gas burner or burners projecting flames therein and above the chamber a series of metal or refractory members, arranged in a substantially vertical plane, with openings between them which become progressively less as they become more remote from the burner.

The chamber communicates with a radiator column or casing of known form through the openings in the series of members lying in a vertical plane so that the hot products of combustion from the burner or burners pass up and out between the metal or refractory members, which become highly heated and form the heating unit of the radiator.

A number of such units may be assembled in a lateral series with radiator columns above them, or such units may be mounted back to back in relation to a column common to two or more units.

A convenient embodiment of this heating apparatus is to form the chamber in two vertically arranged halves moulded in firebrick or other suitable refractory. The back brick may be substantially flat, except for a forwardly projecting top; and the front brick may have rearwardly directed walls to form the sides of the chamber and a rearwardly sloping upper edge much lower than the top of the back brick. The inner surface of the front brick may be a continuous incline from bottom to top, approaching the face of the back more nearly at the top.

Separable side pieces secured to the front brick, or integral side pieces thereon, are carried up to the forwardly projecting top of the back brick and in the framed opening above the chamber, thus formed, are secured, in a loose manner so that they are free to expand and contract, a number of parallel horizontal rods or tubes. These are preferably of steatite or like refractory material, but may be of metal. These rods or tubes form the preferred arrangement of the "series of metal or refractory members arranged in a substantially vertical plane." The spaces between the rods or tubes will be reduced in a progressive gradation from the bottom upwards.

The two half bricks may be clamped together by a garter clip, or two **U**-shaped strips of metal with outwardly directed ends which are secured together by small bolts and nuts. Such a clamping band may also be a convenient means for mounting the unit in a radiator column or other casing.

The burner enters at the open bottom part of the space enclosed by the front and back fire bricks and may consist of a short horizontal burner tube from which two bat's wing or fish-tail gas burners project upwardly into the space while a gas supply tube is led centrally into the horizontal tube from below where a suitable control cock is provided in the ordinary way.

Pipe Joints

Among recent patents is one (No. 531,091; application date, June 27, 1939) granted to the Staveley Coal & Iron Company, Ltd., and E. Freer. It relates to pipe joints. The object is to provide spigot and socket pipe joints which can be readily and economically jointed in position without the labour of caulking. It is a further object to provide improved pipe joints which possess a measure of flexibility so as to enable them to withstand vertical or lateral angular movements of the pipes, due, for example, to subsidence or displacement of the ground in which the pipes are laid, while remaining perfectly tight and leak-proof.

Fig. 1.

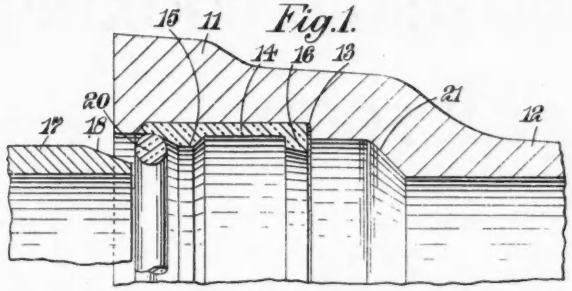
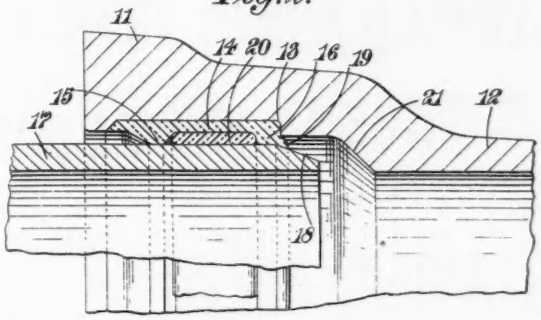


Fig. 1 is a half-section through a pipe joint in accordance with the invention prior to the entry of the spigot into the socket; Fig. 2 is a similar view of the joint when completed.

The joint comprises a pipe socket 11 cast on the end of a length of pipe 12. The socket is hollowed out on the inside to form an annular recess 13 which extends from near the mouth of the socket nearly to the bottom thereof and fits a resilient rubber sleeve 14 which forms one element of the packing of the joint. This sleeve has two inwardly projecting ribs or annular projections, one 15 towards the end of the sleeve nearer the mouth of the socket and the other 16 at the end of the sleeve nearer the base of the socket. The former rib 15 has an internal diameter such as to enable it to fit loosely on the spigot 17 of the next pipe, which is to be jointed in the socket. The other rib 16 is of a slightly smaller diameter so that it fits firmly on the tapered end 18 of the pipe and it is shaped so that when the socket is fully in place the tip of this annular projection forms a lip 19 which rests on the end portion of the spigot and embraces it firmly thus forming a seal (similar to the seal provided by the lip of a cup leather). Between the spigot and the resilient sleeve there is located a rubber ring 20. The actual cross-section of this ring is circular but it is of sufficient diameter to cause the ring to be compressed into a flattened form when the spigot is in place as shown in Fig. 2. In this position the ring occupies the space between the two annular ribs or projections 15, 16 formed on the sleeve and is held there under compression.

The end of the spigot is tapered at 18. In assembling a joint of this kind the resilient sleeve 14 is first fitted into the recess 13 of the spigot

Fig. 2.



11 and the ring 20 is placed within the mouth of the sleeve just outside the annular rib 15. The tapered end 18 of the spigot 17 is then entered within the ring 20 and by steady forward motion the ring is rolled and compressed past the rib 15 into the space between the two ribs 15, 16 which locate it and hold it in this, which is its final jointing position as shown in Fig. 2. The parts are so dimensioned that when this position has been reached, the tapered end 18 of the spigot will have been thrust through the rib 16 inside the resilient sleeve and the lip 19 on the rib 16 will be closely applied around the tapered portion of the spigot.

The length of the socket is made such that the tapered portion of the spigot when the parts are in the position just described will be some distance from the base 21 of the socket, the distance being sufficient to accommodate the maximum spigot movement allowed by deformation of the compressed resilient sleeve 14 and roll packing 20 under angular movement of the joint.

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Gas Products Prices

The London Market

Mar. 3.

Present values of Tar Products in London are as under: Pitch is nominal; creosote 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha 2s. 3d.; and 90/160 pyridine about 15s.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Mar. 3.

The average prices of gas-works products during the week were : Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9½d. to 10d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d Heavy naphtha, North, 1s. 5d. to 1s. 6d. Creosote, *ex* works, in bulk, North liquid and salty, 4¼d. to 4¾d. ; Scotland, 4¼d. to 4¾d.; low gravity, 4¼d. to 4¾d. Fuel Grade 4d. to 4¼d. Carbolic acid, 60's, 3s. 9d. to 3s. 10½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4¼d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, March 1.

Market conditions are steady and no material alteration in value of any product is anticipated in the near future.

Refined tar remains at 4¼d. to 4¾d. per gallon in the home market and 3¼d. to 3½d. per gallon for export, both f.o.r. naked.

Creosote oil is well looked after with quantities changing hands at the following prices: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid remains rather dull although makers' prices are maintained as under: Pale, 99/100%, 2s. to 2s. 2d. per gallon; Pale, 97/99%, 1s. 9d. to 1s. 10d. per gallon; Dark, 97/99%, 1s. 6d. to 1s. 7d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha continues to command as available round 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha is quoted at 1s. 8½d. to 1s. 9d. per gallon for 90/160 grade and 1s. 4½d. to 1s. 5½d. per gallon for 90/190 Heavy Naphtha.

Pyridines are not commanding much attention at about 16s. to 17s. per gallon for 90/160 grade and about 18s. to 19s. per gallon for 90/140 grade.

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A.R.P.

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GAS STOCKS AND SHARES

The gilt-edged market continued to attract the bulk of the business last week, and prices were well maintained. British Funds remained firm at their previous levels and the confidence also extended to India and Colonial stocks. Home railway debentures and guaranteed stocks also received some attention. The volume of business in the industrial section was more limited, although under the lead of Courtaulds with its increased dividend a number of favourites closed at slightly higher levels. There was more activity among oil shares, and several showed improvement, while more activity was discernible in the South African mining section. Rubber and tea shares remained dull and neglected.

The number of recorded transactions in the Gas market was heavier than for some weeks past, and it will be seen in the lists below that price movements last week were by no means all in a downward direction. Among those stocks marked *ex* div. last week there are several instances where any losses on this account have been speedily recovered—*e.g.*, South Suburban ordinary which gained 5 points, and Tottenham with a rise of 3. On the other hand, Brighton dropped 5 points to 65, and Southampton 4½ to 55. On the Provincial Exchanges the three Great Grimsby stocks, after standing at their former levels for a long period, were marked down 10 points each, but on support Newcastle 4% preference rose 4 to 80. Other than *ex* div. markings there were no changes in the Supplementary List.

The Wandsworth and District Gas Company is distributing a final dividend on the consolidated stock of 2% (against 1¾%), making 4% for the year as compared with 5% for 1939, and the Directors of the South-Eastern Gas Corporation have announced that the dividends on the 4½% and 4% preference shares of the Corporation for the six months ending March 31, 1941, will be paid on that date.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 27.	Rise or Fall on week.
1,767,439	Sept. 16	7	7	Alliance & Dublin Ord. ...	103—108	...
374,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	Nov. 4	5	5	Asscd. Gas & Water U'd'ts Ord.	11/6—13/6	..
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/6—16/6	+1/-
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—13/-	—1/-
561,370	Feb. 17	7	7	Barnet Ord. 7 p.c.	95—100	...
300,000	Oct. 14	1/99/32	1/4/8	Bombay, Ltd.	19/6—21/6	..
690,407	Feb. 24	7	7	Bournemouth 7 p.c. max. ...	102—112	—3
362,025	Dec. 16	4	4	Do. 4 p.c. Deb. ...	87—92	...
659,955	Aug. 19	6¾	4¾	Brighton, &c., 5 p.c. Con. ...	60—70	—5
855,000	Sept 30	8	6	Brit. Gas Light Ord.	75—85	...
545,000	Dec. 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	..
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	+2
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—1	..
626,860	Feb. 3	6	6	Cardiff Con. Ord.	87—92	...
24,500	Sept. 23	7	7	Colombo 7 p.c. Pref.	19/—21/-	...
764,169	Oct. 7	/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/-	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/-	...
1,748,935	July 22	2	3	Commercial Ord.	28—38	—2
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62	...
286,344	Feb. 17	5	5	Do. 5 p.c. Deb.	85—90	...
807,560	Feb. 24	6	6	Croydon sliding scale	80—85*	...
644,590	,,	5	5	Do. max. div.	75—85*	+2½
620,385	Dec. 30	5	5	Do. 5 p.c. Perp. Deb. ...	90—95	...
179,500	Feb. 10	5	5	East Surrey 'B,' 5 p.c.	60—70	...
176,461	Dec. 16	5	5	Do. 5 p.c. Deb. (Irred.)...	87—92	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/-	...
19,123,018	July 29	3⅜	4½	Gas Light & Coke Ord. ...	10/6—11/6a	...
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	40—45	..
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	61—66	+1
2,993,000	July 8	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	70—75	—½
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	70—75	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	101—106	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	99—104	
700,000	Sept. 9	3½	3½	Do. 3½ Red. Deb. ...	80—85	..
5,600,000	May 13	4	8	Imperial Continental Cap. ...	42—47	—1
43,820	Jan. 27	3½	3½	Do. 3½ p.c. Red. Deb. ...	75—80	...
231,978	Feb. 24	5	5	M.S. Utility 'C' Cons.	66—71*	—2
918,657	,,	4	4	4 p.c. Cons. Pref.	70—75*	—2
675,000	Nov. 11	14	14	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	105—115	
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	90—95	+1
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/-	...
597,972	,,	-/10⅝	-/10⅝	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	
2,328,714	Sept. 2	1/-	-/7⅝	South East'n Gas Cn. Ld. Ord.	7/—9/-	—1/-
1,000,000	,,	-/10⅜	-/10⅜	Do. 4½ p.c. Red. Cum. Pref.	14/—16/-	...
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/6—12/6	...
6,709,895	Aug. 5	4	4	South Met. Ord.	38—43	+½
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	80—90	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	60—65	...
1,895,445	Dec. 30	3	3	Do. 3 p.c. Perp. Deb. ...	59—64	...
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	98—103	+1
1,543,795	Feb. 24	4	2	South Suburban Ord. 5 p.c. ...	55—65*	+5
512,825	,,	5	5	Do. 5 p.c. Perp. Pref. ...	73—83*	—2
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	60—65*	—3
250,000	,,	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	78—83*	—2
888,587	Dec. 16	5	5	Do. 5 p.c. Perp. Deb. ...	93—98	...
750,541	Feb. 10	5	2	Southampton Ord.	50—60	—4½
350,000	Feb. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	..
1,076,495	Feb. 24	5	5	Tottenham & District Ord. ...	65—70*	+3
338,555	,,	5	5	Do. 5 p.c. Pref.	78—83*	—2
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	13/—15/-	...
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	..
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/-	...
745,263	Dec. 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/—14/-	...
1,200,000	Sept. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	85—90	+1
380,606	Aug. 5	7	6¾	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	July 8	3½	4	Wandsworth Consolidated ...	60—70	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—65	...
1,343,964	Dec. 16	5	5	Do. 5 p.c. Deb.	92—97	...
383,745	,,	4	4	Do. 4 p.c. Deb.	75—8C	..
558,342	Feb. 24	5	5	Watford & St. Albans Ord. ...	82—87*	—1
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 27.	Rise or Fall on week
351,685	Dec. 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	,, 23	4	4	Bristol Gas Co., 4 p.c. New Deb.	83—88	...
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	Aug. 19	5	5	Cheltenham, 5 p.c. Cons. Ord....	88—93	...
42,500	Dec. 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Feb. 24	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	65—75*	...
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Feb. 10	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	,, 10	6	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
117,425	Feb. 5	8	8	East Wight, 5 p.c. Cons. Ord. ...	100—110	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.... ...	65—75	...
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	..
156,600	Feb. 24	5	5	Hampton C't, 5 p.c. Cons. Ord.	67—72*	—1
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	50—60	...
10,845	,, 2	7½	7½	Do. 7½ p.c. 2nd Pref.	50—60	...
50,000	Feb. 24	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70*	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref. ...	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	87—92	...
76,501	Dec. 30	4	4	Reading, 4 p.c. Perp. Deb. ...	70—75	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	Dec. 16	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	,, 30	5	5	Southampton, 5 p.c. Red. Deb.	90—95	...
363,575	Dec. 30	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	94—99	...
202,019	Oct. 14	6¾	6¾	Tunbridge Wells, 4 p.c. Scale ...	67—72	...
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	88—93	...

PROVINCIAL EXCHANGES

						Quotations Feb. 21.	
47,756	July	26	6	5	Bath Cons.	94—98	...
122,577	July	22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	July	15	5	5	Bristol, 5 p.c. max.	88—90	+1
120,420	Dec.	16	4	4	Do. 1st 4 p.c. Deb.	92½—94½	...
415,250	,,		4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
328,790	,,		5	5	Do. 5 p.c. Deb.	107—110	...
157,150	Feb.	3	5	6½	Chester 5 p.c. Ord.	98—101	...
92,500	Dec.	16	4	4	Do. 4 p.c. Pref.	79—81	—1½
36,430	,,		3½	3½	Do. 3½ p.c. Deb.	79—84	...
41,890	,,		4	4	Do. 4 p.c. Red. Deb. ...	93—97	...
542,270	Aug.	12	9	6	Derby Cons.	103—105	...
55,000	Dec.	16	4	4	Do. 4 p.c. Deb.	75—80	...
10,000	Aug.	19	10	10	Great Grimsby 'A' Ord. ...	155—165	—10
6,500	,,		10	10	Do. 'B' Ord.	155—165	—10
79,000	,,		10	10	Do. 'C' Ord.	145—155	—10
732,000	Feb.	24	4	4	Hartlepool G. & W. Cn. & New	61—63*	...
2,167,410	Feb.	17	6	6	Liverpool 5 p.c. Ord.	88½—92½	...
245,500	Dec.	16	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	July	15	4	4	Do. 4 p.c. Deb.	98—100	...
20,000	Dec.	23	5	5	Long Eaton 5 p.c. Pref.	9—11	..
80,000	,,		5	5	Do. 5 p.c. Deb.	87—92	...
2,430,267	Feb.	10	5	5¾	Newcastle and Gateshead Con.	16/6—17/6a*	..
682,856	,,		4	4	Do. 4 p.c. Pref.	79—81	+4
776,706	Dec.	23	3½	3½	Do. 3½ p.c. Deb.	80—85	...
277,285	Oct.	21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	July	26	5	5	Newport (Mon.) Ord.	89—93	...
13,200	Sept.	16	8⅞	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	,,		6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,		5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Feb.	3	10	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,		7	7	Do. 'B' 7 p.c.	113—123	...
1,806,339	Aug.	26	6½	6½	Sheffield Cons.	114—116	...
95,000	Jan.	6	4	4	Do. 4 p.c. Deb.	96—98	...
332,351	Feb.	3	6	6	Sunderland 6 p.c. max. ...	107—112	..
140,778	Feb.	12	5	5	Weston-super-Mare Cons. ...	79—84	—1
64,338	Dec.	30	4	4	Do. 4 p.c. Deb.	80—85	...
33,340	,,		7½	7½	Do. 7½ p.c. Deb.	135—140	...

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

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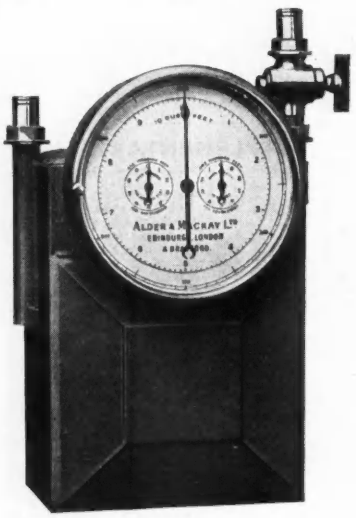

The dial is 9 in. in diameter and a large pointer demonstrates on the outer of the two large circles the hourly rate by one minute observation; and on the inner circle 5 cubic feet and 10 cubic feet in the 100 and 200 cubic feet meters respectively.

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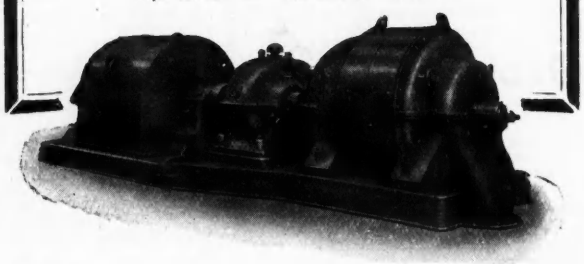

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